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ASSESSMENT OF THE POTENTIAL APPLICATION OF "SMART CARDS" IN THE PASSENGER TRAVEL INDUSTRY

Prepared for the
Transportation Development Centre
Transport Canada

by

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and
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January 1988

Library and Information Centre / Centre de Documentation (GSLA)
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Un sommaire en français de ce document
est inclus avant la table des matières.

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REPORT DOCUMENTATION FORM

1. Transport Canada Report No.	2. TDC Project No.	3. Recipient's Catalogue No.
TP 8994E	6821	

4. Title and Subtitle	5. Report Date
Assessment of the Potential Application of "Smart Cards" in the Passenger Travel Industry	January 1988
	6. Performing Organization Report No. 85-196

7. Author(s)	8. Transport Canada File No.
Gary D. Roberts, P.Eng., J.D.E. Wong, B.Eng.	D1450-103-80

9. Performing Organization Name and Address	10. DSS File No.
W.R. Davis Engineering Limited 1260 Old Innes Road Ottawa, Ontario K1B 3V3	14SD.T8200-6-6544-A
	11. DSS or Transport Canada Contract No T8200-6-6544/01SD

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Transportation Development Centre (TDC) 200 Dorchester Blvd. West Suite 601, West Tower Montreal, Quebec H2Z 1X4	Final
	14. Sponsoring Agency Code TDC 6821

15. Supplementary Notes	16. TDC Project Officer
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17. Abstract

This report provides a preliminary assessment of the potential for smart cards in the transportation industry with emphasis on their use (or usefulness for) elderly and disabled travellers.

A survey of the current market and technology trends with respect to smart cards was conducted, and prosective users were interviewed.

Findings show that smart cards would be more applicable to frequent travellers (i.e. frequent fliers); however, disabled and elderly travellers would also realize some benefit.

The conclusions of this study indicate that there are many applications for smart cards, but due to technical problems in the industry and the high start-up cost that an application would face, demonstration of the cards should be conducted in order to enhance public awareness of the benefits of the cards. Also, a consistent set of standards needs to be developed to ensure economic development and widespread implementation.

18. Key Words	19. Distribution Statement
Smart Card; Optical Memory Card; Transportation; Elderly;Disabled; Handicapped;	Limited number of copies available from the Transportation Development Centre on request.

20. Security Classification (of this report)	21. Security Classification (of this page)	22. No. of Pages	23. Price
Unclassified	Unclassified	65	

TDC/CDT 79-005
Rev 86

Canada

Transports Canada / Transport Canada
Développement / Development

FORMULE DOCUMENTAIRE DU RAPPORT

1. N° du rapport Transports Canada	2. N° de l'étude — CDT	3. N° de catalogue du destinataire
TP 8994E	6821	

4. Titre et sous-titre	5. Date du rapport
Assessment of the Potential Application of Smart Cards in the Passenger Travel Industry	Janvier 1988
	6. N° du rapport de l'organisme exécutant: 85-196

7. Auteur(s)	8. N° de dossier — Transports Canada
Gary D. Roberts, P. Eng., J.D.E. Wong, B.Eng.	D 1450-103-80

9. Nom et adresse de l'organisme exécutant	10. N° de dossier — ASC
W.R. Davis Engineering Limited 1260 Old Innes Road Ottawa (Ontario) K1B 3V3	14SD.T8200-6-6544-A
	11. N° de contrat — ASC ou Transports Canada: T8200-6-6544/01SD

12. Nom et adresse de l'organisme parrain	13. Genre de rapport et période visée
Centre de développement des transports (CDT) 200 ouest, boul. René-Lévesque Tour ouest, suite 601 Montréal (Québec) H2Z 1X4	Final
	14. Code de l'organisme parrain: CDT 6821

15. Remarques additionnelles	16. Agent de projet — CDT
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17. Résumé

Ce rapport rend compte de l'évaluation préliminaire faite sur la possibilité d'appliquer la technologie des cartes à mémoire aux transports et plus particulièrement au transport des personnes âgées et à mobilité réduite.

Un tour d'horizon des applications actuelles et des tendances qui se dessinent a été fait et des utilisateurs éventuels ont été interviewés.

La recherche a montré que les cartes à mémoire conviendraient davantage à ceux qui sont appelés à se déplacer souvent, mais aussi que les voyageurs âgés ou handicapés pourraient y trouver certains avantages.

Le rapport conclut que les applications possibles des cartes à mémoire sont nombreuses, mais que, eu égard aux difficultés techniques inhérentes et au coût de premier établissement élevé, il y aurait lieu de procéder d'abord à l'expérimentation d'un système à cartes à mémoire pour attirer l'attention du public sur les avantages d'un tel système. Il ajoute que des normes cohérentes devraient être élaborées dans le but de permettre la plus grande diffusion possible des cartes à mémoire de manière à en réduire le prix de revient et à en assurer la viabilité économique.

18. Mots-clés	19. Diffusion
Carte à mémoire, carte à mémoire optique, transports, personnes âgées, à mobilité réduite, handicapés.	Le Centre de développement des transports dispose d'un nombre limité d'exemplaires.

20. Classification de sécurité (de ce rapport)	21. Classification de sécurité (de cette page)	22. Nombre de pages	23. Prix
non classifié	non classifiée	65	

SUMMARY

The study was conducted by W.R. Davis Engineering Limited for the Transportation Development Centre under DSS Contract No. T8200-6-6544/01SD. The objective of the study was to conduct a preliminary evaluation of smart card technology with regard to its application to the transportation industry and specifically its use by elderly and disabled travellers. The scope of this preliminary study was limited to the following:

- conducting a literature search of smart card technology,
- conducting telephone interviews with system suppliers and potential users,
- defining potential applications,
- considering the simulation of a typical interaction between a disabled traveller and a terminal,
- developing preliminary design, cost and site specifications
- conducting a cost benefit analysis.

Smart cards are portable, personalized cards, very similar to credit cards in size and function, but with the capability to retain information and make calculations (due to the presence of microchips embedded in the card). They are known by many other names - integrated circuit card, microcard, electronic memory card with read/write and calculation capability, super smart card with key pad and screen built in, and optical memory card. The primary benefit of such cards is that they are unique to the individual: the owner carries a personal database with computational ability, allowing for faster and more efficient exchange of information in a confidential manner.

It became obvious during this study that the requirement for international design and operational standards must be a strong priority to make the cards flexible for use internationally, and hence economically viable. A review of current technology, including that the type of microprocessor and memory, chip design, and mounting, indicates that the most common type of smart card contains a 4 or 8 bit microprocessor and a small non-volatile, programmable read-only memory (PROM). Trends indicate that a card with a 16 bit processor and 64K bytes of electrically erasable programmable memory (EEPROM) should be available in the near future at a reasonable price. Dedicated-purpose cards performing basic logic functions are cheaper to make and provide more usable memory for the same amount of physical space. A third type is an optical memory storage card that holds up to 2 megabytes of data (800 pages of text) and that is not really "smart" at all.

Standards governing chip designs are defined by the International Standards Organization (ISO). Trends in card design, particularly in chip mounting and assembly, are toward the use of tape automated bonding and chip assembly encapsulated in epoxy after application of a waterproofing coat to the vinyl card material. Card life is generally about two years on average due to the physical design of the card rather than the chip rating which extends to ten years.

Although costs are difficult to quantify owing to production volume variations, current prices for Integrated Circuit (IC) based cards are in the range of $10 to $50. The maximum price

for an 8K byte processor card can be as high as $80. With manufacturing costs of $2 each (memory only) or $5 each (read/write), laser cards are more cost-effective. The total cost of the smart card system must also consider the cost of the card interface. IC card readers have been priced in the $1500 range. Basic readers can cost as little as $100 when mass produced. Interface units for lasers have been produced for less than $700.

A study of potential transportation applications was based on interviews with potential smart card users. It concluded that the primary user would be the frequent traveller, who sees the potential benefits as being faster ticket processing and more convenient reservations. Disabled travellers also perceive potential benefits, including improved communications, easier access to special travel arrangements, and individualized information with regard to specific policies. Travel agents did not see any potential benefits in smart cards, which they considered to be direct competition for their services.

In terms of transportation mode, the general feedback was that air would be the only applicable mode. The perceived cost for the infrastructure was considered too high for rail and bus. Besides the cost constraints, there were perceived differences in methodology between the air passengers and rail and bus passengers which would not make smart cards applicable to rail and road transportation.

A preliminary evaluation of the design and cost estimate of a smart card based system for use in an airline terminal indicated that the total cost per system would be approximately $30,000. This is above the cost of the cards themselves. Based on a preliminary analysis of the benefits, which would stem from reduced carrier personnel requirements, it is apparent that a smart card based system would require a significant pay back period.

SOMMAIRE

La recherche sur les cartes à mémoire faite pour le Centre de développement des transports par la W.R. Davis Engineering Limited en vertu du contrat de M.A.S. no. T8200-6-6544/01SD, avait pour but de faire une évaluation préliminaire de la possibilité d'appliquer cette technologie aux transports et plus particulièrement à celui des personnes à mobilité réduite : personnes âgées et handicapés. Le mandat de l'équipe d'étude a été le suivant :

- faire une recherche documentaire sur les cartes à mémoire;
- faire des interviews téléphoniques auprès des fournisseurs, d'une part, et des utilisateurs possibles, d'autre part;
- trouver des créneaux d'utilisation;
- décrire le scénario possible d'une interaction type entre un voyageur handicapé et une installation terminale;
- élaborer un devis descriptif, estimatif et d'implantation préliminaire du système envisagé;
- faire une étude de rentabilité.

Les cartes à mémoire sont des cartes personnalisées quasi-identiques aux cartes de crédit par leurs dimensions et leurs fonctions mais elles sont, en plus, dotées d'une mémoire et d'une logique grâce au circuit intégré qui y est logé. Elles se présentent sous diverses formes : carte à circuit intégré, micro-carte, carte à mémoire électronique, carte à mémoire électronique capable de lire/écrire/calculer, carte intelligente avec clavier et visuel intégrés, carte à mémoire optique. Le premier avantage de ces cartes est qu'elles sont avant tout personnelles : le propriétaire porte donc sur lui une base de données qui lui est propre, capable de faire des calculs et de communiquer plus rapidement et plus efficacement, dans la plus totale sécurité.

La recherche a mis en évidence la nécessité d'établir des normes internationales de conception et d'utilisation de ces cartes dans le but d'en permettre la plus grande diffusion possible de manière à en réduire le prix de revient. Le tour d'horizon de cette technologie, qui a porté en autres sur les mémoires, les logiques et les circuit intégrés utilisés, et sur les techniques de réalisation a montré que dans la plupart des cas la carte à mémoire renferme un circuit intégrés 4 ou 8 bits et une petite mémoire morte programmable non volatile. La recherche a montré également que très bientôt on trouvera sur la marché à un prix raisonnable une carte à mémoire morte programmable, effaçable électriquement, de 64 kilo-octets et a processeur 16 bits. Les cartes dédiées effectuant les fonctions logiques de base reviennent moins cher tout en ayant plus de mémoire utilisable dans le même espace. Un troisième type de carte est la carte à mémoire optique ayant jusqu'à 2 mégaoctets, soit l'équivalent de 800 pages de texte, mais qui n'a aucune véritable fonction logique.

Les normes applicables aux circuits intégrés proviennent de l'ISO (Organisation internationale de normalisation). Pour la conception de ces cartes et plus particulièrement le montage et l'assemblage des composants, la tendance va maintenant vers le procédé de transfert automatique sur bande et l'encapsulation de la puce semi-conductrice dans une résine époxyde après la pose d'une couche isolante sur le substrat en vinyle. Si une carte ne dure que deux

~~dure que deux~~ ans en moyenne, c'est sortout à cause de sa d ans en moyenne, c'est surtout à cause de sa dégradation physique plutôt que de celle de la puce qui, elle, peut durer une dizaine d'années.

Bien que difficiles à chiffrer en égard aux écarts dans les séries produites, les prix des cartes à circuit intégré les plus couranment pratiqués se situent dans la gamme des 10 à 50 $, bien que le prix d'une carte à processeur 8 kilo-octets puisse atteindre les 80 $. Avec leur prix de revient de 2 et de 5 $, selon qu'elles sont à mémoire seulement ou avec fonctions lire/écrire, les cartes au laser ont le meilleur rapport avantages/coût. Dans le prix de revient total d'un système complet, il faut tenir compte de l'équipement d'interfaçage. Un lecteur de carte à circuit intégré peut coûter jusqu'à 1 500 $, mais en production série un lecteur de base ne reviendra pas à plus de 100 $. Pour les cartes au laser, des lecteur ont été fabriqués à prix de revient inférieur à 700 $.

L'étude des applications possibles des cartes à mémoire aux transports s'est fondée sur des interviews avec des utilisateurs éventuels. Il est apparu que le principal utilisateur serait celui qui est appelé à se déplacer souvent, qui y verrait une façon plus rapide et plus commode d'acheter un titre de transport ou de retenir une place. Les personnes à mobilité réduite y verraient, elles aussi, certains avantages, notamment pour communiquer, avoir accès à des services particuliers et s'informer sur les conditions particulières les concernant. Quant aux agents de voyage, ils ne voient aucun avantage à ces cartes qu'ils considèrent comme un élément de concurrence, pour leurs services ou direct.

Pour ce qui est du mode de transport à privilégier, les opinions ont été unanimes : le transport aérien et lui seul. La raison evoquée est un coût que l'on estime trop élevé dans le cas des transports ferroviaires et routiers. Mais, outre la considération de coût, il y aussi une différence au niveau des modalités d'organisation des voyages qui font que les cartes à mémoire ne seraient guère utiles dans les transports terrestres.

Le devis estimatif préliminaire d'un système utilisant des cartes à mémoire, implanté dans un aérport, montre un coût global par système de quelque 30 000 $, qui vient s'ajouter au coût des cartes proprement dites. Se fondant sur une analyse préliminaire des avantages escomptés, qui sont essentiellement une réduction de personnel chez les transporteurs aériens, il devient évident que la période de récupération du coût d'un système à cartes à mémoire serait passablement longue.

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1. INTRODUCTION

1.1 Background

This report is submitted as the final deliverable for D.S.S. contract number 14SD.T8200-6-6544-A entitled:

> "Study to Assess the Potential Application of 'Smart Cards' in the Passenger Travel Industry with Special Emphasis on the Applicability of this Technology to the Needs of the Elderly and Handicapped Travellers".

This project, which was initiated as an Unsolicited Proposal by W.R. Davis Engineering Limited, addresses the use of portable (credit card size) "computer cards" to facilitate personalized information transfer for the travelling public. The term "smart card" has been adopted because the presence of one, or more, micro-chips in the card provides information retention and calculation capabilities.

This report provides a preliminary assessment of the potential for smart cards in the transportation industry, by exploring the subject from a variety of perspectives.

Section 2. examines the current status of the "smart card" technology based on a review of numerous magazine articles. Due to the rapid pace at which the technology is progressing, magazine articles provided the most reliable, state-of-the-art commentary.

The results of interviews with various groups involved with the transportation industry are documented in Section 3. Subjects varied from frequent travellers to carrier personnel and travel agents. Discussions with these individuals provided valuable feedback with regard to applications, system features and the perceived need for the technology.

A demonstration program was to be attempted to simulate the interaction of a "smart card" user with a kiosk at an airport. The reasons that the program was not developed during this contract are provided in Section 4.

A preliminary system definition and the associated cost are provided in Section 5.

Sections 6. and 7. provide study conclusions and recommendations.

1.2 Objectives

The specific aim of the proposed work, was to "assess the potential application of 'smart cards' (plastic cards with read-write memory and computational capability) in the passenger travel industry, with a special emphasis on the applicability of this technology to the needs of the elderly and handicapped traveller".

1.3 Scope

Although the study was to focus on the technology and its specific objectives the "broad" question of confidentiality of personal information was also addressed.

Specifically, the scope of the project was limited to:

- Conducting a literature search of "Smart Card" technology
- Conducting telephone interviews with current system suppliers and users
- Defining potential applications for travellers including disabled travellers
- Evaluating the feasibility of simulating a typical interaction between a terminal ("kiosk") and a disabled traveller
- Developing a preliminary design, costs and site specifications for a typical transportation terminal installation
- Conducting a cost/benefit analysis
- Preparing a final report.

2. TECHNOLOGY BACKGROUND

A smart card is a device similar in size to a credit card. It usually contains one or more integrated-circuit (IC) chips which have the potential to give the card the abilities of a small personal computer. These cards are already in production for various military, medical and manufacturing applications, as well as for use in many information systems. Many of the potential benefits from the use of smart cards have yet to be realized but with the rapid advance of technology, they may yet provide a basis for the next high-tech industry boom.

2.1 Types of Cards

The basic advantage of smart cards over the familiar common-place credit card is that it has the ability to manipulate more information. In fact, a potentially vast amount more. The most common type of smart cards contains a 4 or 8 bit microprocessor and a memory. More important, this memory is of a sort of non-volatile, programmable read-only memory (PROM). This kind of memory has the ability to store and hold information even when the power is disconnected. However, for simpler functions, one can use only dedicated or wired logic. Still another kind of card has no chips at all but consists of optical memories, which are read by a laser system.

The advantages of a programmable microprocessor are that it is capable of complex operations and that it is adaptable to many different situations. This is ideal for use in areas requiring storage of information which is frequently updated and also requiring a reliable security system to prevent break-in, for example in the banking system. The use of a processor limits the memory which may be available, perhaps requiring the use of additional chips. Multi-chip cards can compromise reliability from both a mechanical and security point of view. Dedicated or wired-logic cards, which can perform only basic logic functions and are used in situations requiring only simple operations such as password comparison, are cheaper to make and contain few circuits on a chip. They also provide more usable memory for the same amount of space.

A third type of smart card is not really "smart" at all. It is an optical memory storage card. This kind of read-only memory can be updated and the amount stored on each card is much greater than that found in IC based cards. The Drexler Laser Card, developed by Drexler Technology, holds 2 megabytes of data per card. This is equivalent to over 800 pages of text. Each card is the same size and thickness as a regular credit card.

The storage medium is made of a high-resolution photographic emulsion. There are protective layers on either side of the three-layer film. This medium is photosensitive during manufacturing and then laser-recordable any time afterwards. This allows storage of information on cards en masse during manufacture using photolithography. Alternatively, recording can be done on manufactured cards one at a time by laser recording systems. Fast speed systems are used for writing to an entire blank card while slower, but less expensive systems can be used for information updates. Note that optical memory systems can be updated (data added), but unlike electrically erasable read-only memory (EEPROM) systems, they cannot be erased and new data added. Optical memory cards are thus ideally suited for applications requiring a large amount of data storage space with frequent updates, or an auditable data trail.

2.2 Chip Designs

The choice of a single chip card, as opposed to one with multi-chips, arises as a result of numerous considerations. Presently, many cards contain more than one chip since they were designed using standard chips already in the market. One chip contains the microprocessor while others contain memory.

Multi-chip cards have two disadvantages. First, with more chips on the card the chances of failure due to physical abuse effectively multiply. Secondly, the chip must be somehow externally connected, thus exposing the memory to possible wire-tapping and so causing a breach of security. Single chip cards are becoming more numerous as manufacturers move towards custom-designed chips to increase security and power. Custom designs allow for more specialization and more circuitry to be in each chip.

2.2.1 Standards

Standards which govern chip design are defined by the International Standards Organization (ISO). Manufacturers have only recently been fully able to meet the standards while still containing a relatively large amount (2K bytes) of EEPROM. One chip, designed by Catalyst Semiconductor Inc., is an example of the latest custom-designed single chip package which has been geared specifically for smart card use. ISO standards call for inclusion of protection against electrostatic discharges which are caused by cards being slid in and out of wallets. Discharges have been measured at over 10 kV. The Catalyst chip contains circuitry able to withstand up to 15000 kV. .

Other ISO smart card requirements govern area, thickness, power dissipation and speed. The area of the chip must be less than 5 mils by 5 mils and must be as square as possible to best resist the strains caused by a card being bent. The maximum allowable thickness must be less than that of a credit card, 200 µm. The power that any chip consumes should be minimal, assuring minimum heat dissipation. This is critical with a chip of such small size. The recommended operation frequency is 4.9 MHz and with an instruction cycle time of 814 nanoseconds, this allows I/O communication at the ISO-recommended rate of 9600 baud.

2.2.2 Trends

The Catalyst microcontroller represents a change in the methods of single-chip EEPROM/processor design. The main reason arises from the small size constraints placed upon it for use in smart cards. The two big contenders for this limited space are, of course, the processor and the memory. Catalyst has removed the peripheral circuitry of its EEPROMs and reworked the functions into the microprocessor's microcode. This has allowed a final product containing an 8 bit microprocessor with 3K bytes of ROM, 128 bytes of RAM, and most important, 2K bytes of EEPROM, in a single chip.

The ideal smart card should contain a 16 bit microprocessor with 16K bytes of EEPROM. Catalyst is already on the way to upgrading their current model to contain 8K bytes of EEPROM. To hold more on-board EEPROM using the current manufacturing processes, one would be squeezing the components even closer. With this current technology, the costs skyrocket and reliability suffers.

Without guaranteed reliability, applications in smart cards, where memory storage is critical, would not be feasible. The biggest stumbling block appears to be the lack of development and research, so far, in the EEPROM-based microcontroller. The technology here lags the stand-alone EEPROM chips by at least 4 generations. EEPROMs with a 256K density are currently available. With the growing market and company competition, continuing research into new processes and manufacturing technologies should provide a 16 bit processor with 64K bytes of EEPROM in the near future at a reasonable price.

The current processor-controlled cards being used in pilot projects contain mainly non-volatile electrically programmable read-only memory (EPROM), in one or more chips. Once the memory is full, the card must be brought in to clear the old data or to be replaced. They also require an additional "write" voltage of 21 to 25 volts along with the usual 5 volt supply (to place information into the EEPROM). There are two advantages seen in using new custom-designed EEPROM-based

processors. The "write" voltage can be generated internally with a single-chip design and the memory can be periodically purged of old information without having to be brought into a special issuer terminal.

2.3 Card Design

2.3.1 Chip Mounting

Regardless of whether it is processor-controlled wired logic, the chips must be mounted on the card. Before being placed in a card, the chips are wired into a carrying structure and then encapsulated. The carrier can be a printed circuit board or a polyester film. Circuit boards are thick and will increase the final thickness of the card. Electrical connections are completed by wire bonding, which is easy to make in small devices, but breaks more easily. Wire bonding also increases the overall card thickness. Film carriers are the new alternative, and electrical connections are made by Tape Automated Bonding (TAB), where one side of the polyester film carries electrical paths. Two of these films provide a secure and convenient method to hold together a multi-chip design while maintaining a minimum thickness. The entire assembly is encapsulated in epoxy or some other kind of inert material to prevent corrosion. Vinyl material is used to make the cards. To provide the total hermetic seal needed for human handling, which may also lead to contact with water, an additional waterproof coat is painted on before the epoxy is applied. Another method to human-proof the carrier assembly is a glass seal, which is already used to protect ceramic dual in-line packages (DIP).

2.3.2 Chip Positioning

The chip assembly is usually placed in one of two locations on the card. These locations have been chosen in consideration of the embossed region (the area where card numbers, names and expiry dates are stamped), the card's logo, and the magnetic strip on the back.

The first location is in the upper left hand corner of the card where it will not interfere with the magnetic strip even though it may be partially located in that area. The second spot is also on the left side of the card, between the embossing and the magnetic strip. However, this is a region where highest mechanical stresses occur when the card is bent along its long axis. Tests are being conducted to determine whether the two different areas have an effect on overall reliability. If there is, the preferred area will then be made an ISO standard.

2.3.3 Card Material Limitations

A predominant factor which now determines the durability of a card concerns not the chip package, but the plastic card itself. The current EPROMs being used have a rating of 10000 read/write cycles or 10 years before the material decays to a point of uncertain reliability. The plastic cards which they are embedded within, at the standard 200 μn thickness, have an average lifetime of only 2 years. Several companies are investigating new materials, in search of a possible alternative to plastic.

2.3.4 Standards

Smart card manufacturers have also considered other factors that affect the useful life of a card. ISO standards have been established concerning external electrical contacts, physical make-up, and types of electronic signals used in the interface. Considering the uses already being tested or conceived, such as a bank credit-debit card or a pass key, the smart card will see many interactions each day with terminals. There must be durable electrical contacts on the card surface to resist this daily wear.

With the growing number of interested clientele comes the associated growth in the number of manufacturers and the potential for physical differences. ISO standards dictate a physical size and shape to match that of the standard credit card. Current systems will be able to accommodate smart cards in their functions. For example, the present systems may still be able to read the magnetic strip. This also provides a basis so that different smart card terminals will be able to communicate with different cards. To make them universally readable, the electric signals passing through the interface must be made standard. The level and type of power source must also be standardized. The smart card has no internal supply and is totally dependent upon the interface terminal.

To date, information exchange protocols have yet to be fully determined and agreed upon. This delay may be partially due to the vast number of possible applications which might result in internal functioning and structure of any two types of smart cards being different. In the future, a variety of groups of cards, which each adhere to their own standards, depending upon their general function, may emerge.

2.3.5 Super Smart Cards

Super smart cards, unlike regular smart cards, are capable of independent function. Complete with a small key pad and screen for personal off-line usage, the super smart card can be configured to handle many applications. It provides its own power supply, thus requiring some sort of battery, so that it is not necessary to interface through a reader device. Essentially, it is a small hand-held personal computer with a non-volatile storage capacity provided by its EEPROM.

To date there has been limited response, and initial market surveys indicate a low market desire for the super smart card. Some feel it defeats the purpose of a smart card, which is to provide a small, cheap, secure and simple storage medium. Others feel that the super smart card has been derived from a lack of development in reader technology; consequently, the read/write functions were incorporated into the card itself. Development is slow with problems involving cost and reliability. The risk of failure increases with the complexity. The size of the card might be larger to accommodate more surface components or to provide a more durable card. The cost would rise dramatically, compared to a regular smart card, due to the additional development associated with this type of card. Despite the potential problems associated with the super smart card, some manufacturers feel that a user would be willing to pay more for a card capable of extra functions.

2.4 Costs

2.4.1 Cards

Smart cards costs vary depending upon the type. The current price of an IC-based card is in the range of $10 to $50. Processor-controlled cards will generally cost more than simple wired logic cards, with those using EEPROM at the top of the list. A "flagship" processor card with 8K bytes of EEPROM can cost as much as $80. These values are based on high volume production.

Some cards, which are manufactured presently for pilot projects, are more expensive as they are made in limited quantities and the technology is still relatively new. Costs are expected to decline as more cards are produced en masse and more manufacturers enter this part of the high tech industry. Even in large production numbers, the EEPROM card with 8K bytes may still cost $30.

The quick advances of the smart card industry have brought back the issue of single versus multichip designs. Companies are beginning to market second generation smart cards which are single chip designs. The power of the cards continues to grow, thus more and more circuitry must be packed into each chip. As more gates are squeezed onto a chip, the manufactured cost rises exponentially. Two chips may be more

expensive than one, but only if they are the same scale of integration. A single large scale integration chip will cost more than two small scale integration chips by the law of semiconductor manufacturing yield. The claim that two chips are less secure because of possible linetapping is true, but with the more powerful designs incorporating 8 or 16 bit microprocessors and more memory, data encryption is well within a card's capabilities and is considered the best deterrent against tampering.

Laser cards are already in limited mass production for pilot projects. Cards which have data imprinted at the time of manufacture are expected to cost about $2 each while those with read/write update capabilities are about $5 each.

In comparison to smart cards, the cost of a regular credit card is near $0.75 each. The much higher price of smart cards can be said to be offset by its "intelligence" and its potential in speed and convenience during any type of operation. It would depend upon the value of the application whether any system adopted is cost-effective.

2.4.2 Interfaces

Another cost factor which must be realized when considering a smart card system is the interface terminals. Development of IC card terminals has been slow. The cost of the majority of units varies from $1000 to $2000 although some very simple readers can cost as little as $100 when produced en masse. Read/write terminals for laser systems have been produced for less than $700 per unit. Note, however, that differences between IC and optical memory storage systems, as well as cost, have an influence on which package can be used effectively in the desired application.

2.5 Industry and Market

Smart card technological research and development is only slowly catching up to the ideas for their use. The requirement for heavy investment without immediate short-term profits has caused many North American companies to hesitate in their entry into the field. Due to the lack of a clear cut market, only one major chip manufacturer, Motorola Semiconductor, has a firm smart card program. Others, such as Texas Instruments and Intel Corporation keep a keen but wary eye on developments. There are a number of small chip companies, such as Catalyst, which are specifically developing chips aimed at the smart card.

In France, where smart cards originated over a decade ago, there are over 8 million cards in use in banking and telephone systems. French companies, such as Flonic Schlumberger and the Bull Group, along with the Swiss-based Multimil, have opened subsidiaries in the U.S. These smart card manufacturers prompted replies from the American market with the birth of independent manufacturing firms such as Smart Card International, Intellicard International, and Smart Card Systems.

Japan, with its huge industrial base, is surging ahead with research, development, and test projects. Nearly every major industry, government department, retail store, and financial institution is involved with various applications. Unlike many North American companies, who cannot presently see a high-volume market, and are thus unwilling to invest, the Japanese look ahead one to five years from now and are making the effort to do the groundwork now. Since the 1984 entry of Casio Inc. to the smart card market, soon followed by other major Japanese electronics firms, over forty pilot projects have emerged in the country. This influx of Japanese companies brought about an international market, along with the inevitable international competition which has been deemed good for the industry.

2.5.1 Applications and Advances

Applications abound as the manufacturers work towards contracts to supply interested clientele in every field. The biggest, and original, application for smart cards is for financial applications. These include business chequing transactions, chequebook updating, home banking, a credit-debit system for electronic funds transfer, and credit card operations. One reason may be to replace the masses of paperwork currently required for transactions such as chequing. Another, perhaps more notable, use is the potential to prevent fraud and bad debts. Note that even though credit limits apply each month, the systems currently employed cannot verify how much has been spent to date, so it is possible to break this limit by having many transactions of small amounts. It is also estimated that about 30% of bank transaction costs are used to battle counterfit or stolen cards. The use of smart cards opens up many new security issues. With on-board capabilities the use of smart cards also reduces the amount of on-line computer terminal time needed and the computational abilities of the teller machines, thus saving on hardware costs.

There are serious debates against the possible replacement of the current simple magnetic strip cards with smart cards. The biggest questions involve money and funding. The cost involved with converting the present system over to a new one may be too expensive to consider, even though technological advances will lower the price tag for the support equipment. Suggestions also indicate that it may not be cost-effective in a society with such a decentralized banking system. Since smart cards are still quite a new idea, the technology has yet to be fully developed and has not stabilized. The ongoing developments may be too rapid to have realized all of the faults and weaknesses. This leads to a question of hardware reliability.

Another major factor concerns the bank clients, who would be the prime users of the system. In the sometimes delicate operation of banking, with the introduction of the new technology, there may be hesitation and reluctance from the customer to use it. Present banking habits are

hard to change, particularly with unavoidable benefits such as a "float". Payments are made a month later because of the processing time. Some studies show that only 10% of the public has adjusted to, and actually use, the current automated bank teller machines. This again points to an unwillingness and delay to use new systems. With the recent completion of the teller machine system, it is viewed by some as ridiculous to change the system again so soon. There is also the added costs of the interface read/write machines at the retail points of sale, with the added debate as to who would foot the bill for this hardware.

Finally the banking community is having difficulty deciding upon certain standards governing the operation of smart cards. Although bankers provide one of the main driving forces towards the development of smart cards to be used for financial transactions, progress here is slow as companies discuss the standards necessary to allow universal compatibility. There is also much debate about the values of converting to a new system. This is causing much debate and confrontation between competitors.

The market is also beginning to explode for small-scale independent applications where compatibility with other systems is not necessary. Of the many remote independent functions, the use of smart cards in security systems, is one of the fastest growing. Cards are being used as passkeys to restrict access to buildings or sensitive areas in many complexes. Multimil Inc. manufactures a card and reader system which protects banking and insurance industry computer networks from tampering. Datakey, a small U.S. Company, makes key-shaped chip devices which are used to prevent illegal entry to computer and telecommunications equipment. A more sophisticated system, using cards made by Micro Card Technologies, checks the identity of the user by comparing fingerprints to those digitally stored in memory. Development has already begun on palm or hand prints and voice pattern recognition. In this regard the card can hold not only digitized prints but a complete ID document with the purpose of the visit and designated areas where access will be permitted.

Rapid advances are also being made in the medical field. Cards are being used to hold a variety of information, replacing bulky files of paper. Medical histories and other patient records can be stored on cards, allowing them to be easily transferred to separate medical information systems. Hence, they will not have to be duplicated in many places making it easier to prevent taking the wrong drug or combination of drugs. As well, claims can be easily authenticated.

Blue Cross and Blue Shield of Maryland are currently involved in a major project to retain all patient histories and insurance records using optical memory cards made by Drexler Technology. The test project includes the use of over 1.8 million cards and 60,000 interface machines. The card will even hold EKG readings and X-ray images.

With the ever-growing wealth of information, smart cards are being applied to information storage systems. Developments are being made in the social services where card use would reduce the cost of errors and paper systems. The U.S. Navy is using cards by Smart Card System to hold purchasing records. Part of the University of Paris uses cards from Bull for its students' reports.

The U.S. Pentagon is examining the use of smaller cards to replace the metal "dog tags" worn by personnel; and to hold not only basic identification but service records and critical medical information for use in emergency field hospitals. A similar system could be developed for civilian use with persons who have high risk diseases and medical problems. The communications field could be personalized, saving time with the phone company. Smart cards could be used as ID, for making payments and keeping records. In France, half of the public phones are scheduled to be card operated by 1990. These cards are purchased and will pay for several calls. This not only facilitates usage by eliminating the need for coins but it also deters vandalism as there will be no money held inside the machines.

2.5.2 Financial Pilot Projects

The most advanced system of smart cards used to date in banking operations can be found in France. They are going "full-throttle" to begin adapting their banking systems to accommodate smart cards in credit-debit transactions. With over one million cards presently in circulation, estimates are that by 1989, the number will increase to twelve million. The French Government has issued a directive requiring that all retailers possess readers to provide support for the cards, which are in, or about to appear in, the market by 1990.

There are three major pilot programs taking place. Each test is providing service to one city and the hardware is manufactured by three different companies. Honeywell-Bull serves Blois, Flonic-Schlumberger supplies Lyons while Philips SA looks after the Caen area. These three systems are completely non-compatible, each incorporating very different designs. ISO card standards are not being maintained.

The present system is viewed as an electronic cheque book, which will hopefully replace cash and cheques in transactions. Funds are transferred directly from a user's account to a merchant account.

There are three main codes stored in memory for identification and security purposes. One is the user's account number and identification which can be revealed through any reader. Another is the user's personal identification number (PIN) which the user selects in private. Anyone knowing this code can draw funds against the account. The third is a code which the bank itself can use to verify the card's authenticity and to change certain information such as the withdrawal limit. This code may also be the key to other inquiries by the reader to check on the card.

At the place of sale, the card is plugged into an interface terminal. The user enters his/her PIN and the merchant activates the connection to the host computer. The PIN comparison is done entirely within the card. This provides added security as the terminal does not have to retrieve the PIN which may expose it to external tapping. Magnetic strip cards are easier to forge since the magnetically coded information is constantly exposed. Upon verification of the PIN, the merchant enters the purchased amount and the terminal determines whether the added withdrawal will exceed the monthly spending limit. If there is enough credit left, the transaction is recorded in the card and the merchant terminal, and a hardcopy receipt may be made. To reset the credit allowance, the user merely interfaces with a bank's computer terminal once a month. The merchant can relay his sales the same way, over the phone or by direct communication, so that funds from the purchaser accounts are transferred to his.

This French system offers a self-balancing record file and allows for up-to-date credit checks, as well as cutting down on bank costs and time. The three ongoing projects involve over 60,000 users and 600 merchants and banks. There have been administrative delays and problems with the technology which are holding up initial reports. Although currently incompatible, the three manufacturers have agreed to plans involving common card-terminal interfacing deemed critical if smart card use in these transactions are to proliferate.

In the United States, only Mastercard and VISA have begun projects to evaluate smart cards in the potential to replace the magnetic strip credit cards.

Mastercard is conducting trials involving 70,000 users in Columbia, Maryland and Palm Beach, Florida. Micro Card Technologies manufactures cards and readers for Columbia, while Casio Micro Card supplies Japanese equipment to Palm Beach. Although the cards are only used to verify user identification and credit limit to obtain authorization without calling a central computer, Master Card hopes for more financial and non-financial functions in the future, including credit-debit abilities and holding emergency medical information. While little evaluation has yet been conducted, initial reports indicate that activity is sluggish. The two cards are also

incompatible since Japanese cards do not follow ISO standards closely. They differ in external contact placement, type of processor, amount of memory and most importantly, data exchange protocols.

VISA International has opted for a super smart card design, physically the same size as regular credit cards except for thickness. It contains five IC chips with a Texas Instruments microprocessor and 64K EEPROM. It is able to interface with small computers (IBM PC, etc) as well as card readers with its ISO standard, eight external contacts. Complete with small keyboard and display, it is comparable to a small personal computer. Functions such as calculations, currency conversion, notepad and address book, as well as its prime function as a credit-debit card, can be performed.

So far, only a hundred cards have been manufactured by Smart Card International for initial tests and evaluation. Because of the added keypad and screen, it will be more expensive than other smart cards, though it is felt that users would be willing to pay for more functional abilities. Besides having this advantage, transactions could take place without card reading equipment at the point of sale. This would eliminate the costs of purchasing and installing the hardware. This, however, would lead to less supervision at each transaction, and so may increase the potential for fraud, as it will be harder to determine the authenticity of a card unless more security measures are introduced. In any case, a card must still communicate with the bank's computer system to restore its credit limit.

Although the smart card has the ability to perform as any regular plastic card; it will be some time before it is likely to replace them. The large base of credit card users, which has given smart card manufacturers development incentive, may also be a cause of resistance to a smart card system. Plastic credit card use, involving the magnetic strip and terminals, is widely accepted. The installation of reading terminals and distribution of cards is well advanced. It may not be economically feasible, even with the added "intelligent" functioning of a smart card, to convert the present system. Nevertheless, smart cards will continue to evolve in isolated uses which may require self-contained security, portability, or specific functions where total on-line ability would not be cost-effective.

3. APPLICATIONS ASSESSMENT/RECOMMENDATIONS

The applications assessment was conducted by James F. Hickling Management Consultants Ltd. for Davis Engineering Limited. It addresses the potential applications of "smart cards" in the travel industry.

The backbone of this section is the result of interviews with travellers, carriers and terminal personnel. Discussion of the resulting software design approach is presented, as are estimates of the potential demand, as well as a list of related/competing services and technologies in the travel industry.

3.1 Methodology

Interviews were carried out with a cross section of user groups: frequent travellers, disabled travellers, group organizers, and travel agents. In addition, several carrier representatives and terminal personnel have been interviewed. In most cases, individuals were given a copy of the "Background for Interviews" notes (attached) in advance of the interview. The interviews were informal, generally held over the telephone. Written notes were taken systematically for all interviews.

From the interviews, the most promising applications were labelled and cross-referenced with the potential user groups. A simple design framework was developed, based on two approaches:

(i) the type of data which would be required on the card, and
(ii) a typical sequence of questioning or operation of the system.

Note that technical details of such items as size, type of memory on the card, interfacing requirements, as these issues pertain to the user, were beyond the scope of this task.

3.2 Summary of Potential Applications

3.2.1 Overall Interview Results

- The overall reactions to the concept are varied:
  - Infrequent, young travellers are positive. They see a need for information of various sorts, and have few qualms about communicating with machines.

- Disabled travellers perceived potential benefits in a number of transportation related areas which include ease of communication and information transfer.

- Frequent travellers have no qualms with the technology, but have mixed reactions to the applications and benefits. Information is not a major need, but in many cases, faster processing in terminals is desired.

- Travel agents are quite opposed to the concept. They see it as a competitor to their service.

- Group organizers have no need for the service. Their arrangements, including boarding passes, are all settled days, weeks or even months in advance.

. The potential applications can generally be categorized in two groups (possibly indicating the need for two different "kiosks"):

(i) Carrier-related: ticketing, on-board services, etc. and,

(ii) Non-carrier-related: terminal directions, terminal services, ground transportation, etc.

. Virtually all of those interviewed, including carriers, indicate that the smart card concept is much more applicable to the airline industry than to rail or bus services.

3.2.2 Applications/Specific Uses

. The more promising applications include the following:

- fast issuance of boarding passes;
- bilingual/multilingual communications;
- communication aids for sensory impaired travellers;
- carrier regulations and policies, specific to the individual, embedded in the card; (for example, a wheelchair traveller can prove his eligibility for attendant discounts);
- information and/or reservations for ground transportation at the destination (especially for disabled travellers);
- maps of the seat vacancies specific to the aircraft and flight; coding for such items as smoking, storage; emergency exits;
- information regarding connecting flights (interlining), alternatives in the case of delays or cancellations (including alternative modes of transportation);
- changes (last minute) to return bookings, selected seating class, etc.

- Other potential applications include:

  - promotion/advertising (a source of revenue?);
  - using the smart card for all "out of town" expenses; i.e. hotels, ground transportation, meals, etc. arranged and paid for through the card (replacing a travel agent).

The various potential applications are shown in a matrix with the groups which might benefit from each one in Table 3.1.

3.2.3 Additional Comments

- Most of those interviewed see no need to consolidate or replace existing credit cards. Several individuals cautioned the need for wide acceptance on the part of service-providers before the smart card would be viable. Credit cards are only useful if they can be used in most transactions.

- For virtually all applications, a staff member should be on hand at the kiosks to answer difficult questions and provide general assistance.

- The information provided must be timely (often updated in a matter of minutes), extremely accurate (perfect in the case of gate numbers, boarding times), and comprehensive (addressing the ground services for virtually all destinations).

3.3 Specific Feedback

Comments from the various groups interviewed are summarized below:

3.3.1 Frequent Travellers

Line-ups and delays at ticket counters are a problem for many. Fast, efficient processing in the terminal is desirable. Note, however, that baggage checks take a significant portion of the time at the counter.

Table 3.1 Potential Benefits of Various Smart Card Applications

	POSSIBLE DESIGN OPTION OR APPLICATION	FREQUENT TRAVELLERS	INFREQUENT TRAVELLERS	DISABLED TRAVELLERS	GROUPS
1.	Faster ticket processing	++	+	O	O
2.	More accurate ticket processing	+	+	+	O
3.	Facilitated communications/ reduced mental discomfort at ticket counter	O	O	++	O
4.	Bilingual/multilingual communications	+	+	+	O
5.	Facilitating seat selection (maps, etc)	+	++	++	O
6.	Credit/debit card	+	+	+	O
7.	Specific info. re. terminal directions and services	O	+	++	O
8.	Specific info. re. on-board services	+	++	++	+
9.	Specific info. re. services at destination	+	+	++	O
10.	Specific info. re. weather at destination	O	+	O	O
11.	Info. re. connecting services	++	+	+	O
12.	Individualized info. re. carrier policies	O	O	++	+
13.	Changes to tickets, reservations	++	O	+	O
14.	Personalized medical information for emergencies	O	O	+	O

LEGEND:

O	little or no benefits to the traveller
+	possible benefit to traveller, or benefit to some but not others
++	definite benefit to traveller

- Getting around terminals, terminal services, ground transportation, and other such general information are not generally an issue or requirement.

- Likewise, information with regard to on-board services (meals, movies) is seen as "nice" but not essential.

- Replacement or substitution of credit cards is generally not desirable.

- Use of the card as a business card, for all travel expenses, including ground transportation, hotels, meals) would be desirable. Note that this is in effect what the Air Canada EnRoute Card is.

- Inaccuracies in ticketing are a problem for some, especially in the arrangements made prior to arrival.

3.3.2 Infrequent Travellers

- "Incidental" information, such as weather, meals, movies is very desirable.

- Advance seat selection is desirable.

- An attendant is still deemed necessary. Not all travellers would want to deal with machines.

3.3.3 Disabled Travellers

- Line-ups and processing time are not an issue for most.

- Communication impaired individuals see a great benefit in reducing the time and misunderstandings, which frequently occur with terminal personnel, in the issuance of tickets and the communication of special needs on-board.

- The presence of support staff is always desirable.

- Most travellers would prefer, or need, to have information prior to arrival at the terminal, especially with regard to carrier's regulations and policies. In fact, two individuals cited examples of how the smart card might reduce problems with carrier personnel:

  (i) the card would contain regulations specific to the individual, which many personnel are unfamiliar with, and

(ii) the card would "prove" the individual's eligibility for particular privileges, such as reduce fares for attendants.

- Two "levels" of medical information might be stored: that required by the airline, and more detailed information, less-accessible memory relevant to emergencies.

- Locate the kiosks close to the off-loading points, not at the other end of the terminal. At least two kiosks would be required: one near the "main entrance" of the terminal, and one near the arrival gate.

- Seat selection is very important to mobility-impaired travellers.

- Information/reservations for ground transportation at the destination would be extremely valuable.

- One individual's opinion regarding the potential stigma of a "special card for disabled travellers": The actual and perceived burden imposed by a disabled person on the service-provider is the stigma. If the card helped to make his travel more efficient, the stigma would be reduced.

- Global information requirements seem to be much greater for disabled travellers.

3.3.4 Groups

- For one professional sports team, all bookings, including reserved seats, are made months in advance.

- There are few inaccuracies in ticketing.

- Information on terminals, on-board services, or services at destination is not required. For instance, all ground transportation at the destination is booked well in advance. Travel agents provide most of the rest of the required information.

- "Accounting" is usually carried on one master bill, although the card may have use as a credit tool.

3.3.5 Travel Agents

- Travel agents already cover most of the potential applications of the card. For regular clientele, they have personal databases[1]. This concept is competition!

- The card would be good for:

  - same-day information, such as weather, gate number, etc;
  - changes in multiple bookings;
  - in-terminal information;
  - information regarding smaller carriers at the terminal (i.e. Who is handling ABC Air's ticketing?);
  - many travellers who make their own arrangements, or are not "regulars".

3.3.6 Carriers

- All carriers felt the concept is applicable to air only. The costs for the infrastructure in the rail and bus industries would be too high. Also travellers on those modes perceive fewer "unknowns" with regard to the terminals, on-board services, destinations, transfers, etc.

- Rail passengers usually have their tickets in advance, and there are few queries or problems at the terminals.

- Ticketing, lineups, inaccuracies and communication difficulties are not generally a problem at bus terminals. Virtually all terminals are small, with few crowds.

- There are not many complaints from communication-impaired travellers; more from those in wheelchairs.

- The cards could be as much a tool for travel agents as carriers.

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(1) A portable card (carried by the traveller) is little use to travel agents, who need such information in their own offices.

3.3.7 Terminal Personnel

- Line-ups at airports are manageable,and due more to the tagging of baggage than the issuance of boarding passes. There are serious security implications with individuals checking their own bags.

- Ottawa Airport has plans for an electronic information system, which will include a building floor plan on the screen.

- Service-providers themselves do, and will be, setting up information displays of their own. For instance, OC Transpo will be installing a monitor with bus schedules at the Ottawa Airport.

- Presently, terminal administrators carry out market surveys (re: parking, ground transportation, baggage claims, etc.) through ad-hoc personal interviews in the terminal, often by students.

- The advance notice required for boarding disabled travellers depends largely on the individuals and their particular needs or disposition.

- Printed information may be counterproductive, i.e. overlapping with existing signage, monitors, etc. (information overload), and potentially out-of-date.

3.3.8 Comments

- "Keep the lottery ticket desk away from the smart card kiosk!"

- There is no consensus on the storage of personal/confidential information on the card. For most it was dependant on the process... Can they screen it or check it? Who has access to it? How often is it updated?

- Are there potential legal difficulties if, for instance, out-dated medical information is contained on the card and used in an emergency?

- There is no consensus on the cost of the card. It is not an issue for most of those who see benefit in it. A range of $10-40 seems reasonable. ("No more expensive than a credit card.")

- Caution: Ticketing, other information must be perfect and up to date. The infrastructure/network will be vast and complex. For example, partial information could create more complaints than positive feedback.

- The card must be widely accepted to be of use.

- Replacement or combination of existing cards is not seen as desirable.

- Machines give only binary choices; support staff will be required.

- Obtaining marketing information from the card would bias results (on the presumption that only special groups would use the card).

3.4 Design Discussions

3.4.1 Typical Data Stored on Card

It is anticipated that the card would contain all or part of the following information. The information is all specific to the individual, and can be updated by the user in conjunction with the issues of the card.[2]

1. Personal Identification Number
2. Name
3. Address
4. Special Needs -- call attendant?
5. Preferences
   - speed of processing boarding pass
   - method of communication: audio visual, language, etc.;
   - terminal info. requirements: washrooms, telephones, restaurants, shops, etc.;
   - on-board requirements: seating, meals, movies, music, bar, etc.;
   - destination info. requirements: weather, ground transport, accommodations.
6. Carrier Policies relevant to individual
7. Credit Information.

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(2) Items 7 and 8 are erasable, changed as required; other items are embedded, but can be changed periodically.

8. Trip-Specific Info.
   - flight #, type of airplane, destination;
   - connections, transfers, interlining;
   - special services offered on flight;
   - gate, departure time;
   - credit update.

3.4.2 Typical Sequence of Operation

The steps below show how the system might operate, providing insight into the design of the card and the support infrastructure. There are three main sources of information: the traveller specific information on the card, carrier information from their mainframe computers, and terminal/destination information centred in the terminal administrators' software systems. Each of these three sources must be linked through the kiosk for an effective system.

1. User inserts card.
2. Machine selects mode of communication, calls an attendant if required.
3. Machine selects a seat and shows it on a map of a plane, asks for confirmation.
4. Machine issues boarding pass.
5. Machine gives information on gate number, departure time, routing through terminal.
6. Machine asks if terminal, onboard, or destination information is required:

   (i) <u>Terminal/Destination</u>:

   - weather report;
   - ships, washrooms, restaurants, telephones;
   - ground transportation;
   - accommodation.

   (ii) <u>On-board</u>:

   - meals;
   - movies;
   - storage space location;
   - music;
   - bar.

7. Machine shows information on screen. It could also produce an audio message and/or print out the information as required (ex. blind or mentally impaired travellers).

This list is reasonably complete. All steps will not be followed for each traveller. For example, the frequent flyer's card will explain that boarding pass issuance is the only task required of the machine. The machine will merely ask if "further information is required", in case the traveller wishes specific information.

Virtually all questions can be phrased for binary (Yes/No) responses. The primary application of the card is to eliminate extraneous questions and make the interaction as quick and accurate as possible, by making the information embedded on the card specific to the individual.

Note that an attendant is required, not necessarily at the kiosk, but at least "on call". Also, some approach to tagging and handling baggage is required, especially considering the stringent security requirements at airports.

The need for multiple machines is dependant upon demand. In the short term, the need for two different machines (one for the fast-moving traveller, the other for those with more extensive information requirements) is dependant on the software design and, to a certain extent, demand.

In summary, the main requirement of the card is to store information specific for the traveller, which can be updated frequently. The main requirement of the kiosk is to ask a logical series of questions.

3.5 Demand Estimates

3.5.1 Overall Air Travel in Canada

From the Statistics Canada publication entitled "1986 Tourism and Recreation; A Statistic Digest" (Catalogue 87-410), the following data was obtained:

1984 Air Passenger Trips:

Domestic:	4,872,000
Return from U.S.:	3,017,000
Entering from U.S.:	1,910,000
Return from International:	1,996,000
Entering from International:	1,271,000
All air travel:	13,066,000

Notes:

(1) These values represent the number of trips "returning home"; i.e. to convert to total number of trips, multiply all values by 2. To calculate the number of terminal pass-throughs, the trip values must again be multiplied by 2.

(2) The trends in number of trips taken from 1979 are difficult to follow. In fact, in the period from 1980 to 1984, there was a decrease in domestic air travel. It is suggested that the 1984 values be used to represent the present day.

Of the domestic, overnight trips, 51% were business related.

3.5.2 Air Travel by Disabled Persons

From the 1983/84 Canadian Health and Disability Survey (Statistics Canada Catalogue 82-555E), annual trip-making characteristics of disabled air travellers are given below. Figure 3.2 shows the raw data from this reference.

Total trips, all disabled (1):	2,264,000
Total trips, those who have trouble using airlines (2):	188,000
Breakout of trips by types of disability (3):	
Mobility:	119,000
Agility:	98,000
Visual:	23,000
Hearing:	49,000
Speaking:	8,000
Mental:	6,000

Notes:

(1) "All Disabled" includes any kind of impairment, and is, in itself, not a good predictor of transportation disability.

(2) 8.3% of those who are able to use airline transportation have trouble with it. The assumptions here are that:

(i) the same proportion holds for number of trips (as for number of travellers), and

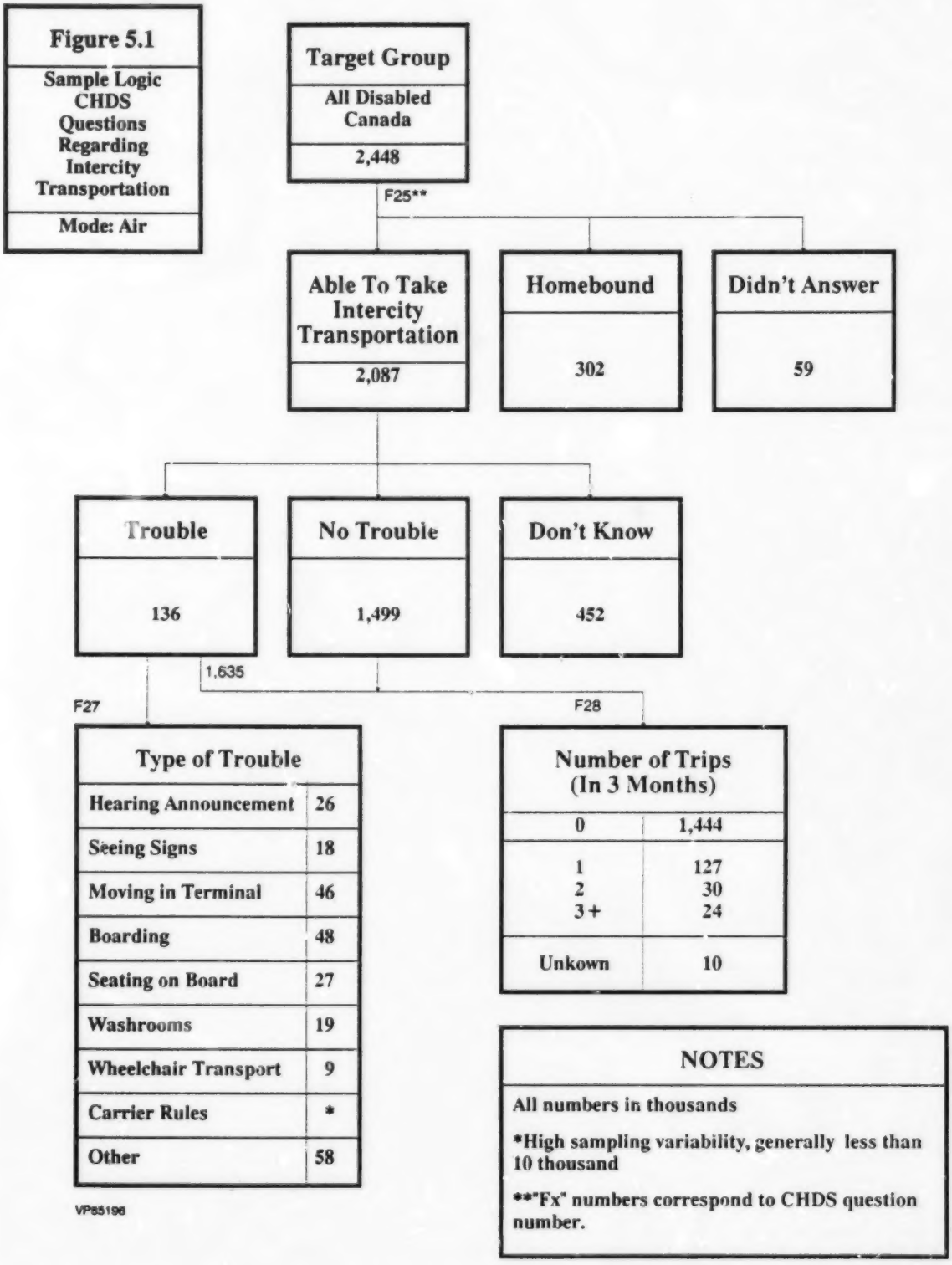

Figure 3.1 Air Travel Statistics

(ii) those who have trouble, travel at the same frequency as all disabled travellers. Both of these assumptions mean that the estimates are maximum values.

(3) These individual values do not add to the total due to multiple disabilities.

(4) To project the values to 1986, multiply by 1.083. Note also that the disabled population is growing more rapidly than the general populace. (However, this is more than compensated by the over-estimation described in Note(2)).

3.6 Related/Conflicting Services and Technologies

In the course of discussions with various groups, several related initiatives in the travel or software industries became apparent:

- "Write your own ticket" initiatives in the airline industry.
- Curb-side check-ins at some U.S. airports (Washington D.C., Tampa).
- Travel agents may soon issue boarding passes.
- Some airlines (American) may soon issue boarding passes ahead of time.
- For high density, business routes, more airlines will issue boarding passes at the gate.
- Reservations, etc. on home computers.
- Automated information kiosks are planned for some terminals (Ottawa). The card may enhance their use.

4. DEMONSTRATION PROGRAM

4.1 Introduction

The purpose of the demonstration software was to simulate typical interaction sequences with an airline ticketing kiosk in order to obtain more accurate user reaction data. Such a demonstration system would also have provided a more detailed evaluation of the specific advantages and disadvantages of smart card technology.

An attempt was made by the software subcontractor to produce a personal computer compatible demonstration program but the resulting simulation was insufficient to illustrate typical smart card interactions. The basic problem was that the scope of this task was underestimated and consequently not enough resources were available to allow a reasonable demonstration program. This eventually caused an amendment to the contract which eliminated the software task altogether.

4.2 Discussion

Although the effort to develop the program as a demonstration tool was unsuccessful, the exercise did point out some of the problems and difficulties which will have to be addressed by any future demonstrations:

- A key requirement of any smart card station is to maximize information transfer and interactive efficiency. A general purpose computer severely limits the demonstration of such efficiency by only providing a confusing, awkward, and non-intuitive keyboard interface. A PC also has severely limited audio output capability.

- Another goal in a smart card demonstration is to illustrate what information is stored on a smart card, what information is available from the kiosk, how the information gets transferred to and from each of these devices and how the information is used. Many users will be mistrustful unless the data flow is both obvious and controllable, but these restrictions cause reduced transaction efficiency and further system complexity.

- A final point is that any demonstration should be complete enough to show that a machine really can deal effectively with the normal traveller including all of their usual confusions and frustrations. This constraint implies much anticipation and effort should be put into the program.

5. PRELIMINARY DESIGN AND COST ESTIMATES

5.1 Introduction

It has been determined that the most feasible application for demonstrating smart cards is in the air travel industry (Section 3.0), where they can be used for several transactions and information storage applications.

5.1.1 Purpose

The requirements for this task were as follows:

1) Determine and document site specifications for a typical terminal application under consideration;

2) Develop estimated costs and perform a brief cost benefit analysis for implementing the smart card technology for passenger travel in Canada.

5.1.2 Scope

Several different applications within the air travel industry have been suggested but this task, in an effort to be practical, will only address the costs of a typical system for buying a ticket and boarding an aircraft. As far as the application of smart card technology for the elderly and the handicapped, ergonomic features will be included that will enhance the interaction with all people including those who are handicapped and those who speak different languages. One benefit that might be useful for the disabled and elderly traveller is that important medical information could be stored on the card.

5.2 Preliminary Design

5.2.1 Considerations

One problem with introducing Smart Cards to the air travel industry is that there is little feedback from previous testing. Another aspect is whether or not a card with computational abilities is required. A laser card, which consists of only memory, and has no computational ability, may be more suited to this application.

The actual setup costs for each type of system would be similar; however, the cost per card would be different. The card containing a computer would range from $10 to $30 dollars where the memory card would cost only $5 to $10 dollars per unit.

The 'pure' memory card is simpler and can store more information than a smarter card. These are also trade offs between making smarter cards and making smarter kiosks. When using a pure memory card system all of the 'smarts' and associated costs are in the kiosk, and this is usually appropriate when there are many more cards than kiosks. Some general applications which may make better use of a CPU on a card are:

- Systems where a card may be used in different applications and must discriminate between readers and what information they are permitted access to.

- Systems where most users have a personal information display device.

- Systems where the readers may not be authentic.

- Systems where all computation and memory requirements can be satisfied by a single chip computer.

The delineation between what information is stored on the card and what information is stored on the host system is also an issue but it is generally obvious where any particular data should reside. In fact most of the information on a card will be duplicated somewhere in the host and is only stored on the card to reduce the access time and the communications costs of retrieving it every time the card is plugged in. A low capacity memory card should be adequate for the air line application outlined here.

Although much work has been expended on the design of ergonomically flexible communications kiosks to make them useful to as wide a population segment as possible, handling a card which must be plugged in presents special problems for several types of handicapped people. In particular cards may be totally inappropriate as a means of making blind people, or people with impaired dexterity, more independent.

On the other hand cards may contain the appropriate information to allow the speech or hearing impaired person to enjoy far superior communication with a machine than with another person.

Security is always an issue where financial transactions and personal information are concerned and as smart cards become more prevalent there will be more attempts to abuse the system. This is offset somewhat by the difficulty of duplicating cards, the excellent ability to encrypt data and capability of using elaborate security checking procedures. However the potential for crime increases with the number of cards and with the increasing power of each card.

If a system were to be implemented, it would have to be able to process people more efficiently than the current way of having a person enter information in a terminal.

A requirement to make the traveller more independent and thus reduce the industry's labour cost.

If the labour and old equipment maintenance costs are higher than the capital cost of smart card systems and their maintenance, then presumably these cost savings will be passed on to the consumer. This will tend to make the idea acceptable to both the consumer and the airlines, although unions may not like it at all. It is likely in such disputes that competition will eventually force the more efficient operating mode.

5.2.2 Site Specification

In order for a smart card or a memory card to work effectively, the traveller would have to be able to purchase an airline ticket, or some type of boarding pass, and proceed to board an aircraft with very little or no human interaction.

'Smart' ticket issuing machine could be built and placed at strategic locations around the airport. The ideal location would be at or near existing ticket counters. The device would be placed in such a way that the luggage could be tagged, accepted, scanned, weighed and distributed to the correct aircraft. If this system was airline specific, there would be little or no difficulty in handling this; if all airlines were connected online, a more complex system of automatically sorting luggage would be required. Regardless of how it is handled, once the bags are given over or placed on some kind of a conveyor system, no person would have access to them, except airline personnel or baggage handlers.

After automated baggage handling is integrated with the smart card system, the traveller would be able to control, locate, recall, confirm the status of, and retrieve his own baggage.

5.2.3 A Typical Terminal Application

The typical terminal can initially be built and/or constructed so that features can be added or taken away as required. Some features will or can be made specific to just the handicapped or elderly traveller.

This study has shown, however, that it is the frequent flier who will benefit the most from the use of smart card technology. For this reason the terminal should initially be made to provide the frequent flier with quick terminal throughput. The user would interact with the system in such a way that regular transactions would occur without airline personnel assistance.

In the initial stages of implementation, the system or terminal would have little extra benefit to the handicapped but could be adapted more to them through such systems as Communi-Cad.

The system should contain intuitive tactile inputs such as symbolically labeled buttons or the much more flexible technique of using a programmable touch display panel which changes its appearance and function to suit the interaction as required. When voice recognition becomes feasible, it should also be available. Initial output devices should include flexible audio and video subsystems as well as a printer for boarding passes, baggage cheques, itinerary and other information. Input/output devices/interfaces should include the card reader/writer, the airline computer interfaces, and an Interac Bank interface.

All subsystems should be located in a privacy booth and positioned to be easily accessed by any customer. Communication should be via international graphical symbols or the language specified on the card.

Interaction should be intuitive with the system leading the customer through the necessary steps. Full context sensitive audio-visual help, explanations and status should be available at any time. Back tracking and "undo" functions should be readily available.

Normal standards for ruggedness and ergonomics should be adhered to throughout.

5.2.4 Cost Per System

In order to meet the initial minimum requirements, a system as per Figure 5.1 could be developed with an estimated quantity cost as follows:

Interactive Touch Display Panel	$ 5,000.
Single Board Computer	$ 1,000.
Printer	$ 500.
Smart Card Interface	$ 1,000.
Power Supply	$ 500.
Packaging	$15,000.
Airline Computer Interface	$ 4,000.
Interac Bank Interface	$ 4,000.
	$31,000.

The actual cards would cost between $5.00 to $10.00 depending on the volume of cards required. Initially, a card containing a microprocessor would not be required.

5.3 Industry Costs

5.3.1 Estimated Total Costs

The actual traffic at individual airports and the cost of storing the required information onto the card and distributing the card will depend on demand.

In order to implement the system fully, cooperation would have to be obtained from banks and airlines, as well as individual airports.

One terminal would cost approximately $50,000.00 to install and get on line with the banking and airline systems. Again, the number of terminals would depend on the demand.

5.3.2 Cost/Benefit

The main benefit of the system will be to the airlines in terms of cost savings due to staff reductions. The traveller should also realize a savings these cost savings will tend to be passed on.

The handicapped traveller will not receive any of the immediate benefits as mentioned until systems such as Communi-Cad are in place and operating. The benefits that the elderly traveller may receive will depend on how well they adapt to the technology.

The card used will have to be low in cost for the travelling public to want to carry another wallet card, but this will be alleviated when the "smart card" is integrated enough to handle all card transactions.

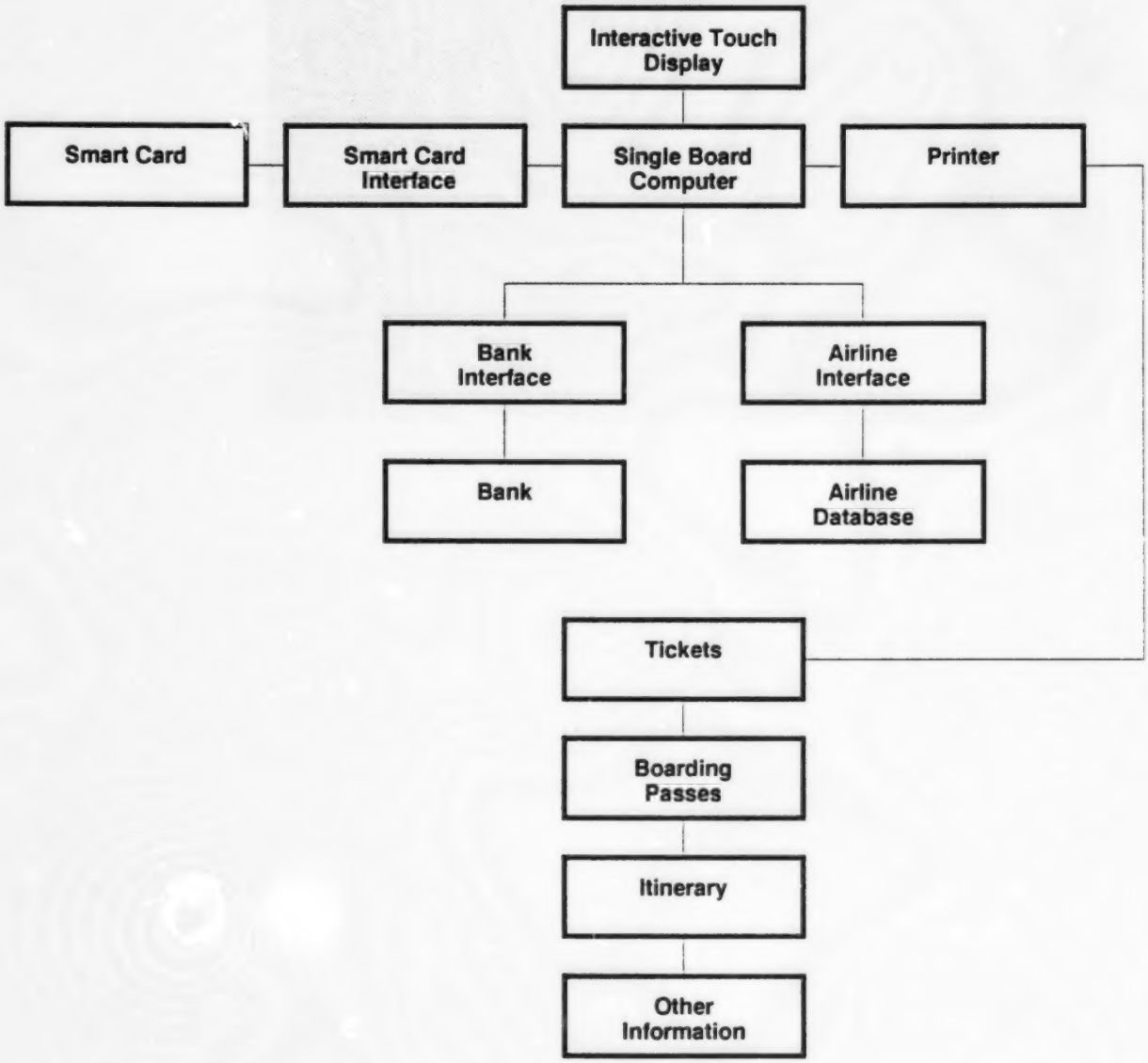

Figure 5.1 System Concept

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In a crude approximation, one kiosk replaces one counter clerk. The maintenance costs of the old equipment tend to cancel with the maintenance costs of the smart card system. It takes about one year's salary to pay the capital cost of one terminal. Assume it costs $5.00 to issue each card and one million cards are issued in twenty years ($5M). If 100 jobs more are eliminated by 100 machines, $9.5M is saved in twenty years. This simple analysis indicates that the savings take a long time to pay back the costs, especially when it is clear that most of the cards would have to be issued in the first few years

A couple of factors which were not accounted for are the development costs of the smart card system and the likelihood that the card system would be installed as the old equipment was ready for replacement thus saving the cost of new equipment. Other factors such as the possible savings by going to a paperless system and the savings in card costs which would occur if the card was also used for other applications, would also have some impact.

The intention here is to give some indication that careful design is required to make smart cards cost effective, but these are factors which can be manipulated during system design to improve the bottom line.

5.4 Remarks

In order to further determine the usefulness of smart card technology in the travel industry, a study should be undertaken with an actual terminal and smart card.

This terminal could be set up as a demonstration at various airports across Canada and people could be given the opportunity to interact with the system. The terminal demonstration program could simulate connection to bank and airline databases.

Initially the system could be set up to run on a trial basis for the business traveller who may have to fly from Ottawa to Toronto on short notice.

The real test of whether the traveller will accept the smart card is when they can evaluate it firsthand.

6. CONCLUSIONS

Card technologies abound, with new twists appearing regularly. Most of these technologies appear technically feasible but only credit cards have so far been proven to be widely viable in an economic sense. This is because they are cheaper to produce, but also the equipment needed to use credit cards is very simple to manufacture, and operate. The cost is thus much lower. Standardization efforts are being made but a universal standard is not likely because of the diversity of card applications. Much of the commitment to smart cards appears to be centered in France and Japan, although pilot projects are occurring in several other countries.

There are many exciting application ideas for the use of smart cards, but the learning curve has not flattened out yet and the entry costs are still high. Another impediment to widespread use of smart cards is that smart card experts know very little about specific industry applications and industry experts know very little about smart cards. The opinions of industry experts about smart cards are still very speculative and not usually very positive. This is due partially to a lack of exposure and partially to standard business conservatism. Applications such as rapid transit systems, where the smart card could eliminate the driver's responsibility of checking bus passes and allow a real charge per kilometer, may receive less enthusiasm than inferior applications strictly because of the timing and the people interviewed.

The majority of interviewees felt that the best chance for a viable smart card application existed in the air travel industry and specifically the frequent flyer could make the best use of the technology. This conclusion seemed to be mainly due to the increased money associated with air travel.

The data requirements for this application are relatively low and an on-card central processing unit (CPU) is not necessary.

Out of 26 million person flights in Canada per year, about 190 thousand are made by people with significant handicaps. Providing an effective simulation of a smart card system is a significant task although it will be necessary if better accuracy is desired from interested parties.

A quantity price estimate for a smart card system is $50,000., but significant design is also necessary since the technology and the application are both new. A typical terminal design stresses universal ease of use and efficiency. The cost-benefit ratio can be radically affected by design decisions, but it is still a fairly long time before the smart card investment begins to pay off.

7. RECOMMENDATIONS

It is a fairly well accepted fact that smart cards are going to be implemented in many applications with the biggest question mark being - when. The main impediment to Canadian industry adopting smart cards is their lack of exposure. With a major mandate of Canadian government to help fledgling industries develop as quickly as possible into internationally competitive concerns, two recommendations can be identified to spur private industry:

1. To help overcome the lack of exposure, an effective demonstration system should be put together and exhibited around the country.

2. To speed up introduction of applications, the government should develop a consistent set of useful standards to suit Canadian industry. This is an important step because it effectively reduces the cost of cards when they can be shared by many applications and there are no industry investors which are interested in all other industries, even if they could afford to develop the standards.

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Companies Contacted

Catalyst Semiconductor, Santa Clara, California.

Drexler Technology Corporation, Mountain View, California.

Intellicard International, Colorado Springs, Colorado.

Micro Card Technology, Dallas, Texas.

Multimil Incorporated, Richardson, Texas.

Smart Card International, New York, New York.

APPENDIX A

BACKGROUND FOR INTERVIEWS (WITH TRAVELLERS)

The document attached was sent to each of the individuals before the interviews were carried out. Also attached is a blank used by JFH during the interviews to record the information obtained.

POTENTIAL APPLICATIONS OF "SMART CARDS" IN THE TRAVEL INDUSTRY

BACKGROUND FOR INTERVIEWS (WITH TRAVELLERS)

INTRODUCTION OF THE CONCEPT

"Smart cards" are portable, personalized cards, very similar to credit cards in size and function, but with the capability to retain information and make calculations (due to the presence of microchips embedded in the card). The primary benefit of such cards is that they are unique to the individual; i.e. the owner has in his/her wallet a personal database with computational ability, allowing for faster and more efficient exchange of information in a confidential manner, and reducing the requirements for large central databases. These cards are presently being used in such applications as bank accounts and personal medical histories.

It is felt that smart cards may be useful in the travel industry for various reasons:

- to facilitate the issue of tickets at the terminal, speeding up the process and reducing errors;
- to allow for automatic credit/debit accounting, eliminating cash transfers;
- to allow for better communication with travellers with special needs, through the use of special equipment;
- to provide travellers with information specific to themselves, such as services and weather at their destination, boarding and access details within the terminal, etc.;
- to facilitate carriers' tasks of special seating, collecting passenger data, etc.

Smart cards are more secure than other identification devices, including credit cards. Confidential information is stored in parts of the card's memory which is accessible only to the issuer.

BACKGROUND

Transport Canada, through the Transportation Development Centre and its contractors, Davis Engineering, James F. Hickling and DEMAC Software, has undertaken a study of the potential use of "smart cards" in the travel industry. This study is underway, scheduled for completion in the summer of this year. The end product will be: (i) a report assessing smart card technology, applications for the travel industry, and costs & benefits of implementation; and (ii) a software program, demonstrating a typical session at a kiosk using the smart card.

Input from travellers is required in order to properly assess the concept. The process here is not a statistical survey, or even a formal interview, but a general discussion of ideas, alternatives, pros and cons, etc.

The purpose of this document is to prepare the reader for discussions with Mr. Brian Guthrie of James F. Hickling Management Consultants, regarding travellers' views towards the use of smart cards in the travel industry. Because the subject is relatively complex, some form of preparatory description of the concept is necessary.

POSSIBLE APPLICATIONS

Three possible applications of smart card usage are described below, detailed in a step-wise fashion, from the perspective of the traveller. Note that the concept can apply to most public modes of intercity travel (air, rail, bus, marine, etc.), and most carriers within each mode. However, in the near term, the concept is seen as most applicable to the airline industry, and would likely be initiated by selected carriers.

A. The Frequent Traveller

1. The traveller applies for, and obtains, a personalized smart card, usable with most carriers. The card contains such information as: preferred seating location, smoking/non-smoking, meal preferences, credit status, etc.

2. The traveller makes a reservation with the carrier directly, or through a travel agent, quoting the card number (as with a credit card at present).

3. At the terminal, the traveller inserts the card in a machine at one of several conveniently located "kiosks". The machine issues several items:

    - the ticket;
    - a boarding pass, automatically accounting for the traveller's seating preferences, and offering alternatives if required;
    - baggage tags, to be attached by the traveller; (a baggage conveyor and attendant would be adjacent to the kiosk);
    - information regarding departure time, gate, terminal directions, services onboard, etc.;
    - information specific to the traveller's destination, such as ground transportation, weather, accommodation, etc.;
    - an account statement, showing the individual's credit balance on the card.

4. At the destination, the traveller could use the card once again to obtain more specific information on ground transportation, accommodations, etc. Further transportation reservations could be made.

B. The Disabled Traveller

The steps would be identical to those described in (A) above, with two additional components:

- o Some of the kiosks at the terminal would have special equipment designed for communication, mobility and agility impaired persons. The machine would automatically communicate with the traveller in the appropriate mode. In addition, an attendant would be present for assistance, as required (including loading baggage).
- o In addition to the information issued in step 3 above, the disabled traveller would receive information specific to individual needs. For example, availability of accessible services, directions through the terminal, etc.

C. Group Travellers

Again, the same steps would be followed as in (A); however the smart card would be issued to the group leader (i.e. team manager, tour guide, etc.). All ticketing and information dissemination would be accounted for in one smart card transaction. The perceived advantages here are the reduced processing time and the capability to handle deviations within the group (in terms of seating, routing, etc.)

DISCUSSION/QUESTIONS

The questions below are presented to stimulate discussion and to raise some of the issues involved in the smart card concept. Written answers are not required; the questions will be raised in the forthcoming interview with Mr. Guthrie.

1. Would you like to reduce the amount of time you spend at terminals (in lines, loking for directions, etc.) ?

2. Do you have difficulty obtaining or exchanging information in terminals (i.e. reading/understanding notice boards, communicating with ticket agents or terminal staff, etc.) ?

3. Would you prefer to be issued your ticket/boarding pass by an agent or a machine ?

4. Have tickets, information, etc. issued to you in the past been inaccurate ?

5. Do you use credit or travel cards ? How many ? Would you prefer to combine the functions of these cards into one ?

6. Do you use automatic banking machines ? Do you feel comfortable using them (in comparison to dealing with people) ?

7. Do you have difficulties (physically or mentally) getting around in terminals ? Would personalized printed instructions help ?

8. Do you wish you had more information (before departure) with regard to onboard services ?

9. Do you wish you had more information (before departure) with regard to your destination (transfer details, ground transportation, accommodation, weather, etc.) ?

10. Would you pay $5-$25 for a smart card which provided the above services ? What is a reasonable cost ?

11. Would you be concerned that personal and confidential information is contained on the smart card ?

12. Would you prefer to have your ticket and billing information prior to arriving at the terminal ?

INTERVIEW NOTES

NAME:

TITLE:

COMPANY/ORGANIZATION:

MAILING ADDRESS:

TELEPHONE NUMBER:

DISPOSITION RELEVANT TO THIS STUDY:

DATE INTERVIEWED:

INTERVIEWED BY:

NOTES:

TRAVELLER INTERVIEWS

1. **REDUCE TERMINAL TIME ?**

2. **DIFFICULTIES IN TERMINAL COMMUNICATIONS ?**

3. **PREFERENCE FOR AGENT OR MACHINE ?**

4. **INACCURACIES IN TICKETS ?**

12. **PREFERENCE FOR BOARDING INFO PRIOR TO ARRIVING AT TERMINAL ?**

5. **USE OF CREDIT CARDS; COMBINING FUNCTIONS.**

6. **USE OF BANK MACHINES.**

7. PHYSICAL/MENTAL DIFFICULTIES IN TERMINALS ? PRINTED INSTRUCTIONS ?

8. MORE INFO ON ON-BOARD SERVICES ?

9. MORE INFO ON SERVICES AT DESTINATION ?

10. COST FOR CARD.

11. CONCERN RE PERSONAL INFO ON CARD ?

OTHER APPLICATIONS ?

OVERALL ASSESSMENT OF CONCEPT.

APPENDIX B

BACKGROUND FOR INTERVIEWS (WITH CARRIERS AND TERMINAL PERSONNEL)

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It is felt that smart cards may be useful in the travel industry for various reasons:

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The purpose of this document is to prepare the reader for discussions with Mr. Brian Guthrie of James F. Hickling Management Consultants, regarding the views of carriers and terminal staff towards the use of smart cards in the travel industry. Because the subject is relatively complex, some form of preparatory description of the concept is necessary.

POSSIBLE APPLICATIONS

Three possible applications of smart card usage are described below, detailed in a step-wise fashion, from the perspective of the traveller. Note that the concept can apply to most public modes of intercity travel (air, rail, bus, marine, etc.), and most carriers within each mode. However, in the near term, the concept is seen as most applicable to the airline industry, and would likely be initiated by selected carriers.

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    - information specific to the traveller's destination, such as ground transportation, weather, accommodation, etc.;
    - an account statement, showing the individual's credit balance on the card.

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- In addition to the information issued in step 3 above, the disabled traveller would receive information specific to individual needs. For example, availability of accessible services, directions through the terminal, etc.

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DISCUSSION/QUESTIONS

The questions below are presented to stimulate discussion and to raise some of the issues involved in the smart card concept. Written answers are not required; the questions will be raised in the forthcoming interview with Mr. Guthrie.

1. Would you like to reduce the amount of waiting on the part of passengers at terminals (i.e. lineups, etc.) ? Do you see significant benefits in reducing the processing time (per passenger) in issuing boarding passes, providing information, etc. ?

2. Do ticket agents or support staff have difficulty communicating with passengers ?

3. Would you prefer to maintain personal contact with your clients ?

4. Do issued tickets, boarding passes,information, etc. often contain inaccuracies, creating difficulties at the gate or onboard ?

5. Do many travellers have difficulties (physically or mentally) getting around in terminals ? Would personalized printed instructions help ?

6. Do you anticipate the installation of special equipment for disabled travellers ? Would this equipment require special explaination to travellers ? Could the explaination/information exchange be easily automated ?

7. Would you prefer to issue more information (before departure) with regard to onboard services ?

8. Do you have access to information (at the point of departure) with regard to services for travellers at destinations (transfers, ground transportation, accommodation, weather, etc.) ?

9. Do you often receive complaints with regard to:

   - inaccurate tickets or boarding passes;
   - slow processing at the ticket counter;
   - lack of information on terminal directions, terminal services, on-board services, services and weather conditions at the travellers' destination ?

10. Can boarding information and decision-making be made without the input of ticket agents ? Can the sort of transaction anticipated between the traveller (with a smart card) and your central computers be automated, at reasonable cost ?

11. Would you be concerned that personal and confidential information is contained on the travellers' smart cards ?

12. Would you prefer to have travellers' ticket and billing information prior to their arrival at the terminal ?

13. How frequently do you carry out passenger market surveys ? Would you prefer to have more information, more frequently ?

14. What is your present lead-time required to arrange special boarding arrangements for disabled travellers ?

INTERVIEW NOTES

NAME:

TITLE:

COMPANY/ORGANIZATION:

MAILING ADDRESS:

TELEPHONE NUMBER:

DISPOSITION RELEVANT TO THIS STUDY:

DATE INTERVIEWED:

INTERVIEWED BY:

NOTES:

CARRIER/TERMINAL INTERVIEWS

1. REDUCTION OF PASSENGER WAITING TIME.

2. COMMUNICATION DIFFICULTIES ?

3. PREFER PERSONAL CONTACT ?

4. TICKET INACCURACIES ?

12. TICKETING PRIOR TO ARRIVAL AT TERMINAL ?

5. PASSENGER DIFFICULTIES IN TERMINALS ? PRINTED INSTRUCTIONS ?

6. EQUIPMENT UPGRADES ? INFO PROGRAMS ?

7. **INFO ON ON-BOARD SERVICES ?**

8. **SERVICES AT DESTINATIONS ?**

9. **COMPLAINTS (TICKETING, PROCESSING, INFO) ?**

10. **TRANSACTION DETAILS, DECISIONS.**

11. **PERSONAL INFO ON CARDS.**

13. **MARKET SURVEYS.**

14. **LEAD TIME FOR SPECIAL BOARDING ?**

OTHER APPLICATIONS ?

OVERALL IMPRESSIONS OF CONCEPT.

CONTACTS FOR TECHNICAL DETAILS (Reservation systems, Information systems, Software integration, Terminal hardware):

Name:

Title:

Organization/Department:

Mailing Address:

Telephone: